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UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 C.F.R. § 1.53(b))

Attorney Docket No.	Najda 2-8-1 (8018-12)
First Inventor or Application Identifier	Najda et al.
Title	Reverse Statistical Multiplexing....
Express Mail Label No.	EL433_28213US

APPLICATION ELEMENTS
See MPEP chapter 600 concerning utility patent application contents.

ADDRESS TO: Assistant Commissioner for Patents
Box Patent Application
Washington, DC 20231

1. [X] * Fee Transmittal Form *(e.g., PTO/SB/17)*
(Submit an original and a duplicate for fee processing)

2. [X] Specification [Total Pages 28]
(preferred arrangement set forth below)
- Descriptive title of the Invention
- Cross References to Related Applications
- Statement Regarding Fed sponsored R & D
- Reference to Microfiche Appendix
- Background of the Invention
- Brief Summary of the Invention
- Brief Description of the Drawings *(if filed)*
- Detailed Description
- Claim(s)
- Abstract of the Disclosure

3. [X] Drawing(s) *(35 U.S.C. 113)* [Total Sheets 21]

4. Oath or Declaration [Total Pages 5]
   a. [X] Newly executed (original or copy)
   b. [ ] Copy from a prior application (37 C.F.R. § 1.63(d))
   (for continuation/divisional with Box 16 completed)
      i. [ ] DELETION OF INVENTOR(S)
      Signed statement attached deleting inventor(s) named in the prior application, see 37 C.F.R. §§ 1.63(d)(2) and 1.33(b).

NOTE FOR ITEMS 1 & 13: IN ORDER TO BE ENTITLED TO PAY SMALL ENTITY FEES, A SMALL ENTITY STATEMENT IS REQUIRED (37 C.F.R. § 1.27), EXCEPT IF ONE FILED IN A PRIOR APPLICATION IS RELIED UPON (37 C.F.R. § 1.28).

5. [ ] Microfiche Computer Program *(Appendix)*

6. Nucleotide and/or Amino Acid Sequence Submission
(if applicable, all necessary)
   a. [ ] Computer Readable Copy
   b. [ ] Paper Copy (identical to computer copy)
   c. [ ] Statement verifying identity of above copies

ACCOMPANYING APPLICATION PARTS

7. [X] Assignment Papers (cover sheet & document(s))

8. [ ] 37 C.F.R.§3.73(b) Statement *(when there is an assignee)* [X] Power of Attorney

9. [ ] English Translation Document *(if applicable)*

10. [ ] Information Disclosure Statement (IDS)/PTO-1449 [ ] Copies of IDS Citations

11. [ ] Preliminary Amendment

12. [X] Return Receipt Postcard (MPEP 503) *(Should be specifically itemized)*

13. [ ] * Small Entity Statement(s) *(PTO/SB/09-12)* [ ] Statement filed in prior application, Status still proper and desired

14. [ ] Certified Copy of Priority Document(s) *(if foreign priority is claimed)*

15. [ ] Other: ....
....
....

16. If a CONTINUING APPLICATION, *check appropriate box, and supply the requisite information below and in a preliminary amendment:*
[ ] Continuation [ ] Divisional [ ] Continuation-in-part (CIP) of prior application No: _____ / _____
Prior application information: Examiner _____ Group / Art Unit: _____

For CONTINUATION or DIVISIONAL APPS only: The entire disclosure of the prior application, from which an oath or declaration is supplied under Box 4b, is considered a part of the disclosure of the accompanying continuation or divisional application and is hereby incorporated by reference. The incorporation **can only** be relied upon when a portion has been inadvertently omitted from the submitted application parts.
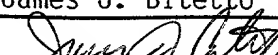
17. CORRESPONDENCE ADDRESS

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IN THE UNITED STATES
PATENT AND TRADEMARK OFFICE

PATENT APPLICATION

Joseph J. Najda, D. Reagan Rice, Allen M. Rush

CASE: Najda 2-8-1 (8018-12)

TITLE: REVERSE STATISTICAL MULTIPLEXING TO ACHIEVE EFFICIENT
DIGITAL PACKING WITH LINK PROTECTION

BOX PATENT APPLICATION
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SIR:

Enclosed are the following papers relating to the above-named application for patent:
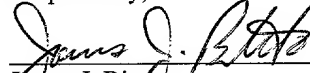
28 sheets Specification, Claims and Abstract
2 sheets of Informal drawings
4 sheets Assignment with Cover Sheet
5 sheets Declaration and Power of Attorney

CLAIMS AS FILED				
	NO. FILED	NO. EXTRA	RATE	CALCULATIONS
Total Claims	23 - 20 =	3	x 18 =	$ 54.00
Independent Claims	3 - 3 =	0	x 78 =	$ 0.00
Multiple Dependent			x 260 =	$
Basic Fee				$ 760.00
			Total Fee:	$ 814.00

Please file the application and charge **Lucent Technologies Deposit Account No. 12-2325** the amount of $814.00,
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Please address all correspondence to **Frank Chau, F. Chau & Associates, LLP, 1900 Hempstead Turnpike,
Suite 501, East Meadow, New York 11554.** However, telephone calls should be made to me at **(516) 357-0091.**
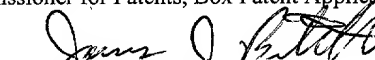
Respectfully,

James J. Bitetto
Reg. No. 40,513
Attorney for Applicant(s)

Date: November 30, 1999
Lucent Technologies, Inc.
600 Mountain Avenue
P.O. Box 636
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CERTIFICATION UNDER 37 C.F.R. § 1.10

I hereby certify that this Application transmittal and the documents referred to as enclosed are being deposited with the United
States Postal Service on this date November 30, 1999 in an envelope as "Express Mail Post Office to Addressee" Mailing Label
Number EL433928213US addressed to: Assistant Commissioner for Patents, Box Patent Application, Washington, D.C.
20231.

James J. Bitetto

REVERSE STATISTICAL MULTIPLEXING TO ACHIEVE EFFICIENT DIGITAL PACKING WITH LINK PROTECTION

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to digital networks, and more particularly to a ring configured system for efficiently packing data while restoring service in the event of a failure.

2. Description of the Related Art

Synchronous Optical Network (SONET) configurations available commercially from Lucent Technologies, Inc., using for example, DDM-2000 equipment, can provide service using a ring configuration which permits a multiplicity of de-multiplex sites, each feeding a customer location, and also provides protection switching for the SONET equipment to restore service in the event of a failure of one link in the optical network.

Unfortunately, this combination of features cannot be readily applied to service configurations using Asynchronous Transfer Mode (ATM) transmission of broadband signals, such as those using Internet Protocol (IP), without having to

5   deploy extra units of digital bandwidth, many of which are not fully utilized. This situation constitutes an economic barrier to the hoped-for deployment of several ATM transmission systems that will provide greater speed for the download of digital data to Internet end customers. The

10   additional equipment also increases system complexity and handling.

Therefore, a need exists for a multiplexing apparatus and method congruous with ATM transport networks in a SONET ring network that includes the capability of

15   restoring service and maintaining transferred data in the event of a failure of one or more links in the SONET ring.

SUMMARY OF THE INVENTION

An asynchronous transfer mode network, in accordance

20   with the present invention, includes a plurality of remote terminals remotely disposed relative to a central office.

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The remote terminals are connected by a ring with two paths. The ring transfers signals thereon in opposite directions relative to each path. The central office feeds duplicate signals on each path. Each remote terminal includes a first

5   multiplexer for routing signals transferred on the ring to and from an asynchronous feeder multiplexer. The asynchronous feeder multiplexer is adapted to route components of downstream signals on a first path of the ring to a destination and to replace the components of the

10   signals on the first path with copies of components of signals running in an opposite direction on a second path of the ring such that at any location in the network both paths provide all signals.

Another asynchronous transfer mode network of the

15   present invention includes a first path for connecting a plurality of remote terminal sites and for transferring asynchronous transfer mode signals in a first direction and a second path for connecting the plurality of remote terminal sites and for transferring asynchronous transfer

20   mode signals in a second direction opposite the first direction. A central office is coupled to the first and

-3-

second paths for feeding duplicate asynchronous transfer mode signals downstream from the central office to the remote terminal sites and for receiving upstream asynchronous transfer mode cells from the remote terminal sites to compare upstream signals and to select a best available upstream signal. The remote terminal sites include a first multiplexer for routing signals transferred on the first and second paths to and from an asynchronous feeder multiplexer. The asynchronous feeder multiplexer is adapted to route components of downstream signals on the path to a destination and to replace the components of the signals on the first path with copies of components of signals running in an opposite direction on the second such that at any location in the network both paths provide all signals.

In alternate embodiments, the asynchronous feeder multiplexer may include protection logic adapted to compare signals received from the opposite directions on the two paths to select a signal to be output. The protection logic may select for the output that signal which remains after a loss of signal has been detected. The protection logic

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selects, for the output signal, a signal having a best

signal quality, e.g., the least number of bit errors. The

signals received from opposite directions may include

components and the protection logic may selectively choose

5   or merge components of each output signal based on the

components having a best signal quality. The network may

include a synchronous optical network (SONET) with at least

an STS-1 optical bandwidth. The network may include

metallic channels in the two paths of the ring, with for

10   example, a DS3 bandwidth.

A method for providing add/drop capability and link

protection in an asynchronous network of the present

invention includes providing an asynchronous transfer mode

network having a plurality of remote terminals remotely

15   disposed relative to a central office. The remote terminals

are connected to a ring including two paths which transfer

signals thereon in opposite directions relative to each

path. Duplicate signals are fed downstream on each from the

central office. The signals transferred on the two paths

20   are routed to and from an asynchronous feeder multiplexer at

each remote terminal. Components of downstream signals on a

first path of the ring are routed to a destination, and the components of the signals on the first path of the ring are replaced with copies of components of signals running in an opposite direction on a second path of the ring such that at

5   any location in the network both paths provide all signals.

In other methods, the step of comparing signals received by the central office from opposite directions on the two paths to select an output signal may be included. The step of comparing signals may include the step of

10   selecting the output signal which remains after a loss of signal has been detected. The step of comparing signals may include the step of selecting the output signal which includes a best signal quality. The step of comparing signals may include the step of merging components of each

15   signal based on the components including a best signal quality.

These and other objects, features and advantages of the present invention will become apparent from the following detailed description of illustrative embodiments thereof,

20   which is to be read in connection with the accompanying drawings.

BRIEF DESCRIPTION OF DRAWINGS

The invention will be described in detail in the following description of preferred embodiments with reference to the following figures wherein:

FIG. 1 is a block/flow diagram showing a network/data flow for an asynchronous digital network in accordance with the present invention; and

FIG. 2 is a block/flow diagram showing an ATM feeder multiplexer and data flow in accordance with the present invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

The present invention includes a system and method whereby a multiplexer, preferably a statistical multiplexer (SM), part of an asynchronous transfer mode (ATM) transport network, is designed not only to read out downstream ATM cells (traffic) destined for that location but also to insert (write) into those same cell locations, that continue downstream toward the next site in the ring, copies of the corresponding traffic destined for upstream transport. The SM also receives, in the upstream direction, ATM cells

that are identical in content to those downstream cells to
be read out. The SM is designed to choose, for the
downstream traffic the SM sends to its subtended elements,
between the downstream cells it receives in the "normal"
downstream direction and those it receives in the normal
upstream direction. The SM makes its choice on the quality
of the ATM cells' content. A link failure will allow the SM
to make a clear decision in favor of the cells that have
passed through the good segments of the ring.

Regarding ATM cells headed upstream, the SM feeds
identical copies of the cells it receives from its subtended
elements into the normal upstream transport path and also
into the normal downstream path as mentioned. At the hub
end of the ring, where duplicate copies of the ATM traffic
are normally received from opposite directions on the ring,
the transport equipment can select the received leg that has
not suffered a transmission failure, not suffered from a
decrease in transmission quality or is consistent with a
default choice when there is no failure or quality problem.

The invention permits for a single digital rate signal,
such as, for example, one at the third level (Digital Signal

-8-

3 (DS3) over a metallic channel, STS-1 when converted to optical format), to carry traffic at full capacity, supplying the several SMs at their downstream sites with ATM cells that begin their downstream journey fully packing the

5   cell capacity of, for example, the STS-1 component of the optical facility. It should be noted that Digital Signal 1 (DS1) or other levels may also be employed for electrical or optical transmission.

At each downstream site ATM cells are dropped off to

10   the subtended elements (e.g., remote terminals), until at the last site in that direction the remaining ATM cells are dropped off. Wherever ATM cells are dropped, those cell positions are replaced with copies of upstream cell traffic.

In the event of a link failure (e.g., fiber/cable cut) all

15   the ATM cells designated for each site are still available for accurate reception by the SM at that site, and all the ATM cells transmitted upstream are available for reception by the ATM network element at the central office end.

The prior art for effecting link protection on a ring

20   with multiple downstream sites ("add/drop" capability) depends on a traffic format that is based on dividing the

transmitted signal into its fixed DS1 or DS3 components.

Advantageously, the ATM service application of the present

invention includes a digital format with capacity, which is

dynamic, that is, a portion of the downstream signal can be

5   dropped off at a site and the site/cell map can be changed

easily and remotely. Further, the digital format can be an

extension of existing ATM technology.

The present invention permits existing ring networks

with deployed remote terminals of digital loop carrier (DLC)

10   systems to support the enhancement of the DLCs to provide

broadband transport of ATM protocol signals. These ATM

protocol signals may be used to offer much faster

downloading of information, such as, for example, Internet

graphics. The present invention permits a service provider,

15   such as, a telephone company, to operate a network adding

ATM capability without being forced to expand the costly

cable facilities comprising the network. The present

invention may be employed, for example, in the AnyMedia

Access System, the SLC-2000 Access System, and the SLC

20   Series 5 Carrier System DLCs.

Referring now to the drawings in which like numerals represent the same or similar elements and initially to FIG. 1, an information transfer network 10 is illustratively shown for one embodiment of the present invention.

5   Information transfer network 10 may include a central office 12 where incoming and outgoing connections are routed to one or more data transfer networks. Information transfer network 10 preferably includes a ring 14 for data transfer to occur. Ring 14 preferably includes a synchronous optical network

10   (SONET) ring; however, electrical rings may be employed. Ring 14 includes an upstream flow (upstream) and a downstream flow (downstream) to provide redundant data packets or cells traveling through network 10. Upstream or downstream is referenced relative to central office 12.

15   Information leaving central office 12 travels downstream, while information traveling to the central office 12 is traveling upstream.

In accordance with the present invention, an asynchronous transfer mode (ATM) cell-based signal is

20   applied to ring 14 from an ATM network 18 which connects from an " edge" element such as an ATM router.

Multiplexers 16, preferably, ATM feeder multiplexers (AFMs), are employed to route information in cells in both the upstream and the downstream directions. In a preferred embodiment, a uni-directional path switched ring (UPSR) 15

5   including two paths carrying oppositely directed signals is employed, which achieves both add/drop and link protection capability in accordance with the invention. Both features are achieved by employing multiplexers 16 in accordance with the invention at each remote terminal site 20. Each site 20

10   may include a location where information cells carried by network 10 are received (i.e., the destination of the data). Each multiplexer 16 is employed at each site 20 with a multiplexer 22, preferably a digital data multiplexer (DDM). Multiplexers 16 may be employed as terminals of an optical

15   fiber network or an electrical network (e.g., using copper cable). An example of ATM feeder multiplexer (AFM) may include an LPA900 AFM-DS3 available commercially from Lucent Technologies, Inc., which is enhanced to support the present invention.

20   Multiplexer 16 is adapted for ATM transfers in, for example, a synchronous network (e.g., SONET) in ring 14.

Multiplexers 22 may include, for example, a DDM 2000 available commercially from Lucent Technologies, Inc.

Beginning at central office 12 and following two downstream paths, downstream signals are double fed into

5   ring 15 in opposite directions. An information component or "cell", signal D_{123}, is directed down ring 15 to multiplexer 22 at site 20_1 and is processed by multiplexer 16_1. The cell delivers a portion of its contents to site 20_1 and outputs cell $D_{23}U_1$. In this way, a portion of the

10   information D_1 is supplied to its destination site 20_1 and upstream information U_1 passing through site 20_1 is incorporated into the cell position previously occupied by D_1. $D_{23}U_1$ is multiplexed and transferred to a next site 20_2. At site 20_2, multiplexer 22 outputs $D_{23}U_1$ to multiplexer 16_2,

15   where D_2 is received at site 20_2 and upstream contents U_2 are received and installed in place of D_2. A new composite cell is output to multiplexer 22 as D_3U_{12}. Again, information addressed for the given site D_2 is received at the site and the contents of the cell are replaced with U_2; U_2 is also

20   launched onto the ring with information flow in the opposite direction. D_3U_{12} is received by multiplexer 22 at site 20_3 and

routed to multiplexer 16_3. Information D_3 is received at site 20_3 and replaced with U_3. Now, a U_{123} signal is routed through multiplexer 22 at site 20_3 and is returned to multiplexer 22 at central office 12. It is to be understood that all information present on ring 14 is available on each of the two paths, at each remote terminal site 20 and at central office 12. In case of a failure of one path, all data/information is capable of being retrieved.

At central office 12, information signals that were duplicated and sent downstream in the opposite direction as described above, are now described. Processing of the signals is provided as above except at site 20_3; D_{123} is input, and $D_{12}U_3$ is output. At site 20_2, $D_{12}U_3$ is input, and D_1U_{23} is output. At site 20_1, D_1U_{23} is input and U_{123} is output and returned to central office 12. U_{123} from both directions are received in multiplexer 22 of central office 12. Both U_{123} signals are compared for each component, e.g., U_1 and U_1 are compared, U_2 and U_2 and U_3 and U_3, etc. Multiplexer 16_{co} is employed for comparing the signals and selecting the "healthiest" one, i.e. the signal with fewer bit errors. An automatic protection switch (APS) or logic device 17 may be

included on each multiplexer 16 to determine the best signal

or signal component of between the two paths of ring 15 for

delivery to the destination of the data. The components of

each signal may be merged to form a best resultant signal or

5   simply to select a remaining signal if one uni-directional

path of ring (UPSR) 15 fails, e.g., a fiber or wire break.

The selected output signal U_{123}'may then be sent to other

networks.

Referring to FIG. 2, an ATM feeder multiplexer (AFM) 16

10   is shown in greater detail. AFM 16 includes an ingress port

102 and an egress port 104 for a first side 106 of ring 15.

First side 106 corresponds with a portion of one path of

uni-directional path switched ring 15 (FIG. 1). A second

side 108 includes an ingress port 110 and an egress port 112

15   which provides a portion of the other path of uni-

directional path switched ring 15 (FIG. 1). A plurality of

connections 114 provide appropriate input and output

connections for multiplexer 16 at an ATM layer to provide

the appropriate cross-connections for transferring

20   information between upstream and downstream paths as

described above. Multiplexer 16 interfaces with a line card

116, for example, an asynchronous digital subscriber line

card (ADSL) plug-in such as one coded LPA400 available

commercially from Lucent Technologies, Inc.

In accordance with the invention, whatever downstream

5   ATM cells are read and sent to the ADSL line cards 116 are

replaced by corresponding upstream ATM cells from the same

set of line cards 116. This feature of the present

invention provides a unidirectional path switched ring

(UPSR) which has the capabilities for add/drop of cells and

10   link protection in which information is redundantly

available at each site.

At the physical layer 100, physical signal ingress is

monitored and loss of signal or AIS (Alarm Indication

Signal) is reported to switches for making proper connection

15   to select the "healthiest data" as will be described.

"Healthy criteria" include bipolar violation and loss of

signal (LOS) at the DS3 level, and/or misrouted cells and

header check error at the ATM layer. At the ATM layer cells

are monitored for virtual connection ingress and a report is

20   issued if an indication of a virtual path-AIS (VP-AIS) or

virtual channel-AIS (VC-AIS) condition is detected.

ATM pass-through switches 120 are included in multiplexer 16. ATM pass-through switches 120, which operate on ATM cells that are not destined for drop-off at this site, are employed as follows. If a physical signal failure, for example, a DS3 LOS, is detected at the ingress 102 of first side 106, then ATM alarm information is sent from the ingress 102 of first side 106 to the egress 112 of second side 108. If a physical signal failure is detected at the ingress 110 of second side 108, then ATM alarm information from the ingress 110 of second side 108 is sent to the egress 102 of first side 106. If no physical failures are detected, then ATM cells are passed-through to the egress of the same side.

ATM cross-connections 122 are employed to bridge the egress 104 of first side 106 to the egress 112 of second side 108. ATM cross-connections 122 are also employed to select between ingress 102 and ingress 110 based on the detected physical ingress state of cells received. Multiplexer 16 is capable of selecting the valid downstream signal from the ATM signals going in both upstream and downstream directions. Protection logic 17 provides decision

making logic to select between duplicate signal components

to provide the best signal. Logic 17 may include a default

setting which is changed if loss of signal or an alarm

indication signal is triggered, or a decision may be made

5   based on signal analysis provided by logic 17. Logic 17

receives DS3 level alarm information from both physical

layers 100, and ATM alarms from ATM cross-connection device

118 and conveys its conclusions to pass-through switches 120

and ATM cross-connections 122. Logic 17 may be included as

10   part of cross-connection device 118. Logic 17 may be

employed at remote stations to compare components of the

signals traveling along ring 15. In this way, a best signal

is chosen for delivery at its destination. For example,

logic 17 may be employed to compare D_3 of D_{123} and D_3 of D_3U_{12}

15   at site 20_3 of FIG. 1.

Advantageously, the present invention permits efficient

data packing by filling locations vacated by data delivered

at a site with data to be sent upstream. By properly

selecting the data which is used to replace delivered data,

20   the present invention provides link protection. The data

present at any location on ring 15 is cumulatively all the

signals on the network, such that despite the several data

exchanges, the dual ring has complete continuity. In the

event of a failure, no data is lost since the data for a

location is available in duplicate at all remote terminals.

5   Having described preferred embodiments of a system and

method of reverse statistical multiplexing to achieve

efficient digital packing with link protection (which are

intended to be illustrative and not limiting), it is noted

that modifications and variations can be made by persons

10   skilled in the art in light of the above teachings. It is

therefore to be understood that changes may be made in the

particular embodiments of the invention disclosed which are

within the scope and spirit of the invention as outlined by

the appended claims. Having thus described the invention

15   with the details and particularity required by the patent

laws, what is claimed and desired protected by Letters

Patent is set forth in the appended claims.

WHAT IS CLAIMED IS:

1.   An asynchronous transfer mode network comprising:

a plurality of remote terminals remotely disposed relative to a central office, the remote terminals being connected by a ring with two paths which transfers signals thereon in opposite directions relative to each path, the central office for feeding duplicate signals on each path;

each remote terminal including:

a first multiplexer for routing signals transferred on the ring to and from an asynchronous feeder multiplexer; and

the asynchronous feeder multiplexer adapted to route components of downstream signals on a first path of the ring to a destination and to replace the components of the signals on the first path with copies of components of signals running in an opposite direction on a second path of the ring such that at any location in the network both paths provide all signals.

2.   The network as recited in claim 1, wherein the asynchronous feeder multiplexer includes protection logic

adapted to compare signals received from the opposite

directions on the two paths to select a signal to be output.

3.   The network as recited in claim 2, wherein the

protection logic selects for the output that signal which

remains after a loss of signal has been detected.

4.   The network as recited in claim 2, wherein the

protection logic selects, for the output signal, a signal

having a best signal quality.

5.   The network as recited in claim 2, wherein the

signals received from opposite directions include components

and the protection logic selectively chooses components of

each output signal based on the components having a best

signal quality.

6.   The network as recited in claim 1, wherein the

network includes a synchronous optical network (SONET).

7. The network as recited in claim 6, wherein the network employs at least an STS-1 optical bandwidth.

8. The network as recited in claim 1, wherein the
5   network includes metallic channels in the two paths of the ring.

9. The network as recited in claim 8, wherein the network employs DS3 bandwidth.

10

10. An asynchronous transfer mode network comprising:

a first path for connecting a plurality of remote terminal sites and for transferring asynchronous transfer mode signals in a first direction;

15 a second path for connecting the plurality of remote terminal sites and for transferring asynchronous transfer mode signals in a second direction opposite the first direction;

a central office coupled to the first and second

20 paths for feeding duplicate asynchronous transfer mode signals downstream from the central office to the remote

terminal sites and for receiving upstream asynchronous

transfer mode cells from the remote terminal sites to

compare upstream signals and to select a best available

upstream signal;

5   the remote terminal sites including:

a first multiplexer for routing signals

transferred on the first and second paths to and from an

asynchronous feeder multiplexer; and

the asynchronous feeder multiplexer adapted

10   to route components of downstream signals on the path to a

destination and to replace the components of the signals on

the first path with copies of components of signals running

in an opposite direction on the second path such that at any

location in the network both paths provide all signals.

15

11.   The network as recited in claim 10, wherein the

central office includes an asynchronous feeder multiplexer

including protection logic adapted to compare signals

received from opposite directions on the first and second

20   paths to select the best available upstream signal.

12.   The network as recited in claim 11, wherein the protection logic selects the best available upstream signal by selecting a signal which remains after a loss of signal has been detected.

5

13.   The network as recited in claim 11, wherein the protection logic selects the best available upstream signal by selecting a signal having a best signal quality.

10   14.   The network as recited in claim 11, wherein the signals received from opposite directions include components, and the protection logic selectively merges components of each of the signals received from opposite directions based on a condition of best signal quality.

15

15.   The network as recited in claim 10, wherein the network includes a synchronous optical network (SONET).

16.   The network as recited in claim 15, wherein the

20   network employs at least an STS-1 optical bandwidth.

17.   The network as recited in claim 10, wherein the network includes metallic channels in the first and second paths.

5   18.   The network as recited in claim 17, wherein the network employs DS3 bandwidth.

19.   A method for providing add/drop capability and link protection in an asynchronous network comprising the
10   steps of:

providing an asynchronous transfer mode network having a plurality of remote terminals remotely disposed relative to a central office, the remote terminals being connected by a ring including two paths which transfer
15   signals thereon in opposite directions relative to each path;

feeding duplicate signals downstream on each path from the central office;

routing signals transferred on the two paths to
20   and from an asynchronous feeder multiplexer at each remote terminal;

routing components of downstream signals on a
first path of the ring to a destination; and

replacing the components of the signals on the
first path of the ring with copies of components of signals
5   running in an opposite direction on a second path of the
ring such that at any location in the network both paths
provide all signals.

20.   The method as recited in claim 19, further
10   comprising the step of comparing signals received by the
central office from opposite directions on the two paths to
select an output signal.

21.   The method as recited in claim 20, wherein the
15   step of comparing signals includes the step of selecting the
output signal which remains after a loss of signal has been
detected.

22.   The method as recited in claim 20, wherein the
20   step of comparing signals includes the step of selecting the
output signal which includes a best signal quality.

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23. The method as recited in claim 20, wherein the step of comparing signals includes the step of merging components of each signal based on the components including a best signal quality.

ABSTRACT OF THE DISCLOSURE

An asynchronous transfer mode network, in accordance with the present invention, includes a plurality of remote terminals remotely disposed relative to a central office.

5 The remote terminals are connected by a ring with two paths. The ring transfers signals thereon in opposite directions relative to each path. The central office feeds duplicate signals on each path. Each remote terminal includes a first multiplexer for routing signals transferred on the ring to

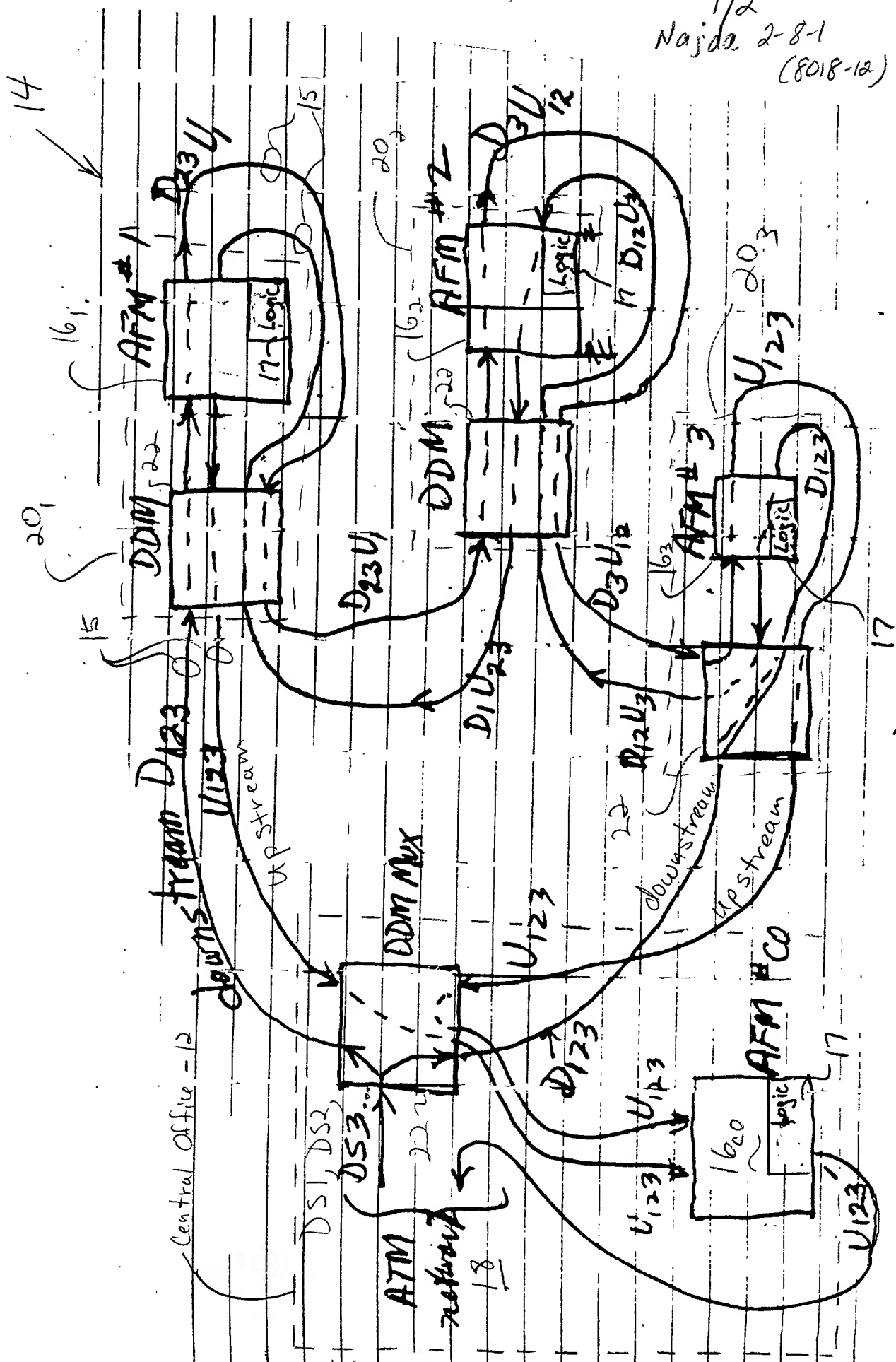10 and from an asynchronous feeder multiplexer. The asynchronous feeder multiplexer is adapted to route components of downstream signals on a first path of the ring to a destination and to replace the components of the signals on the first path with copies of components of

15 signals running in an opposite direction on a second path of the ring such that at any location in the network both paths provide all signals.

FIG. 1

FIG. 2

Nadja 2-8-1 (8018-12)

ATM Layer
Protection Switching
for Ring Networks

PHY-Layer Function

PHY-Layer Function

ATM-Layer Cross-Connection Function

Logic - 17

Egress

Ingress

Egress

Ingress

ATM Connections for traffic used locally in shelf (to line cards)

Line Card

Line Card

Line Card

100

102

104

106

108

110

112

114

116

118

120

122
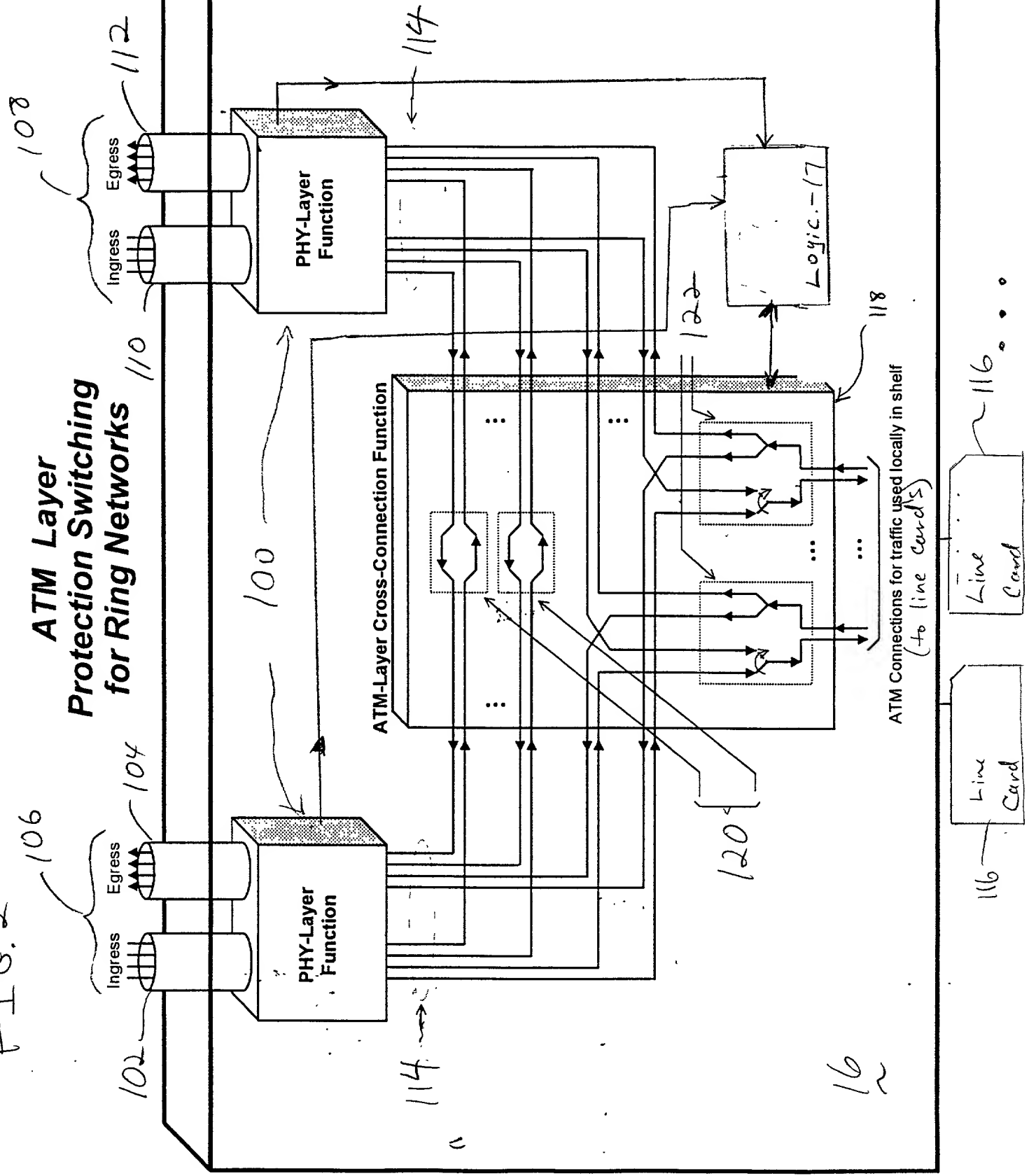
IN THE UNITED STATES
PATENT AND TRADEMARK OFFICE

Declaration and Power of Attorney

As the below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor of the subject matter which is claimed and for which a patent is sought on the invention entitled **REVERSE STATISTICAL MULTIPLEXING TO ACHIEVE EFFICIENT DIGITAL PACKING WITH LINK PROTECTION** the specification of which is attached hereto.

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by an amendment, if any, specifically referred to in this oath or declaration.

I acknowledge the duty to disclose all information known to me which is material to patentability as defined in Title 37, Code of Federal Regulations, 1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, 119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

None

I hereby claim the benefit under Title 35, United States Code, 120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, 112, I acknowledge the duty to disclose all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application:

None

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

I hereby appoint the following attorney(s) with full power of substitution and revocation, to prosecute said application, to make alterations and amendments therein, to receive the patent, and to transact all business in the Patent and Trademark Office connected therewith:

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I hereby appoint the attorney(s) on ATTACHMENT A as associate attorney(s) in the aforementioned application, with full power solely to prosecute said application, to make alterations and amendments therein, to receive the patent, and to transact all business in the Patent and Trademark Office connected with the prosecution of said application.   No other powers are granted to such associate attorney(s) and such associate attorney(s) are specifically denied any power of substitution or revocation.

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